GPD GROUP
Glaus, Pyle, Schomer, Burns & DeHaven, Inc

STRUCTURAL ANALYSIS REPORT

180' Self Support Tower

5721 Shier Rings Road
Columbus, OH 45005

SBA Site Name: Dublin 2, OH
SBA Site Number: OH02759-A

Sprint Site Name: Dublin South - AEP
Sprint Site Number: CB03XC025

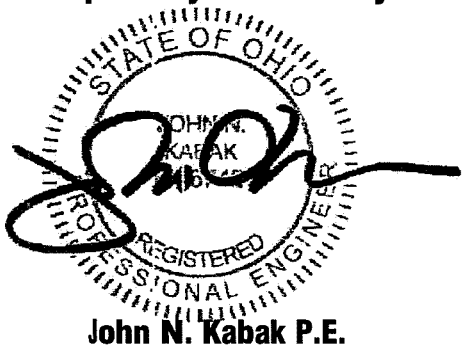
GPD Project Number: 2012778.02759.01

Analysis Results

Tower Components	**62.2%**	**Sufficient**
Foundation	**48.9%**	**Sufficient**

January 17, 2013

Respectfully submitted by:



John N. Kabak P.E.
Ohio #: 66742

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APPENDICES

Executive Summary

The purpose of this analysis is to verify whether the existing self support tower is structurally capable of carrying the proposed antenna and coax loads as specified by Sprint to SBA. This report was commissioned by Mr. Jerry Mergler of SBA.

The existing structure and its foundations have been analyzed per the following requirements:

Governing Code/s	**TIA-222-G & 2011 OBC**
Wind Speed	**90 MPH 3-Second Gust**
Wind Speed w/ Ice	**40 MPH 3-Second Gust**
Radial Ice Thickness	**3/4"**
Structure Class	**II**
Exposure Category	**C**
Topographic Category	**1**

Conclusions & Recommendations

The design of the tower and its foundations is sufficient for the proposed loading configuration considering the above analysis criteria and will not require modification.

Tower Description

The existing 180' Self Support Tower is located in Dublin, OH. The tower was originally designed for Nextel by Rohn in March of 1997. The tower was designed for an 80 mph wind speed with 1/2" ice (with 25% wind load reduction) in accordance with TIA/EIA-222-E. The tower was originally designed to hold the following loading:

Original Design Loading:

Mounting Level (ft)	Number of Antennas	Antenna Manufacturer	Antenna Model	# of Feed Lines	Coax Size (in)
179.5	12		ALP9212	15	1-5/8
	3		ASP973		
	3		15' Mounting Frames		
160	12		ALP9212	12	1-5/8
	3		15' Mounting Frames		
140	12		ALP9212	12	1-5/8
	3		15' Mounting Frames		
120	12		ALP9212	12	1-5/8
	3		15' Mounting Frames		
100	12		ALP9212	12	1-5/8
	3		15' Mounting Frames		

Documents Provided:

Document Type	Remarks	Source
Original Tower Drawings	Rohn Eng. File #: 32232PM, dated 3/12/97	SBA
Geotechnical Report	G2 Project #: 96983, dated 1/14/97	SBA
Original Foundation Drawings	Rohn Eng. File #: 32232PM, dated 3/12/97	SBA
Tower Application	Sprint Network Vision Application, dated 9/27/12	SBA
Previous Analysis	FDH Project #: 11-10193E S1, dated October 13, 2011	SBA

Tower Materials:

Structural Components	Material Strength
Legs	ASTM A-572 (50 KSI Yield Strength)
Tower Bracing	ASTM A-36 (36 KSI Yield Strength) & ASTM A-572 (50 KSI Yield Strength)
Bolts	ASTM A325
Anchor Rods	ASTM A354-BC (125 KSI Yield Strength)

Tower Loading

The following data shows the major loading that the tower supports. All existing/reserved and proposed loading was provided by SBA.

Existing/Leased Loading

Carrier	Mounting Level (ft)	Center Line Elevation (ft)	# of Antennas	Antenna Manufact.	Antenna/Mount Model	# of Coax	Coax Size (in)	Note
T-Mobile	162	162	4	Andrew	TMBX-6517-R2M	11	1-5/8	
			1	RFS	APXV18-206517S-C-A20			
			2	CSA	PCSA060-19-0			
			2	EMS	RR65-19-02DP			
			4	Andrew	ETD19V2S12UB TMAs			
			1	RFS	ATMAA1412D-1A20 TMA			
			1	Andrew	ETW190VS12UB TMA			
			2	Andrew	ETM19V2S12UB TMAs			
			3		T-Frames			
Clearwire	152	152	3	Kathrein	840 10054	3 6 1 5	5/16 3/8 2 1/2	Conduit
			3	Motorola	WAP 450 DAP Heads			
			5	Dragonwave	Horizon DUO ODUs			
			5	Andrew	VHLP2.5			
			3		Standoff Mounts			
			5		Pipe Mounts			
Nextel	142	142	12	Decibel	DB844H90E-XY	12	1-1/4	
			3		T-Frames			
Sprint	120	120	6		5' x1' Panel	6	1-5/8	
			3		T-Frames			

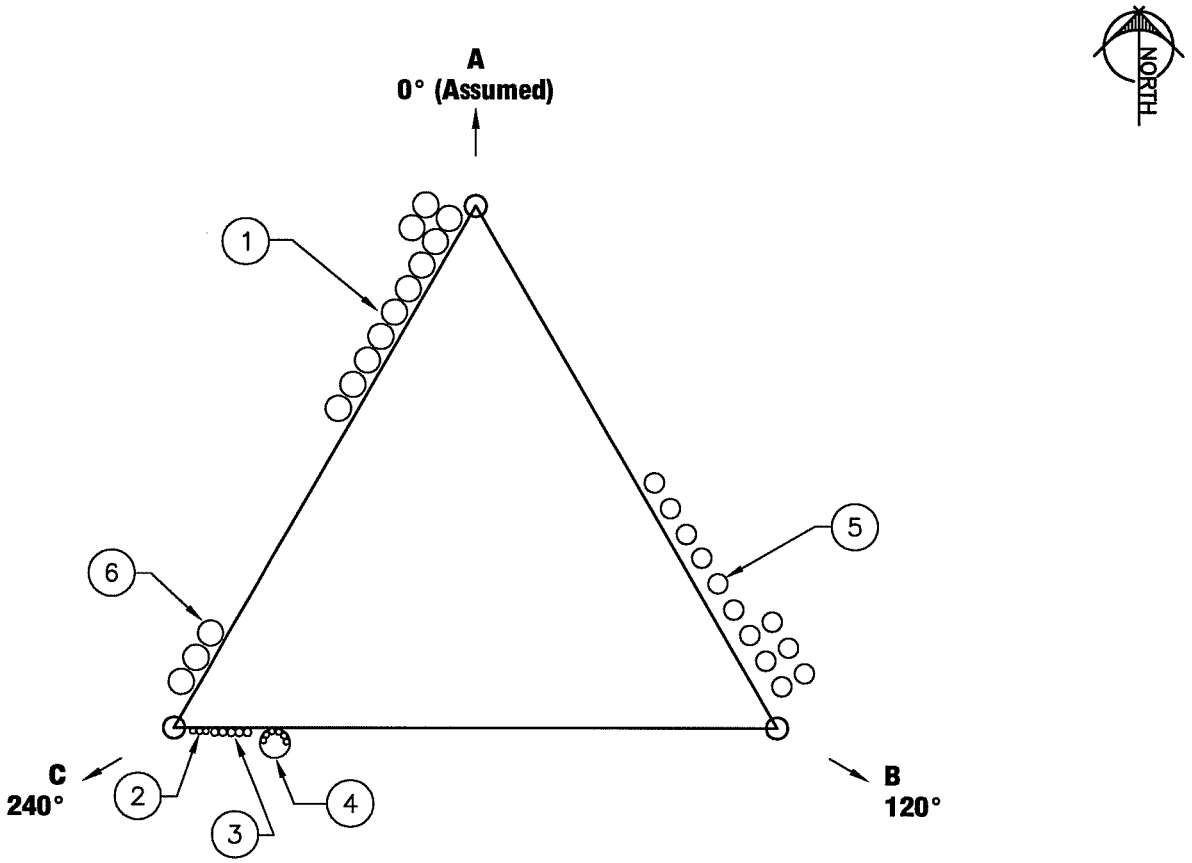
Final Proposed Loading Configuration

Carrier	Mounting Level (ft)	Center Line Elevation (ft)	# of Antennas	Antenna Manufact.	Antenna/Mount Model	# of Coax	Coax Size (in)	Note
Sprint	120	120	2	KMW	ET-X-TS-70-15-62-18-iR-RD	3	1-1/2	1
			1	Powerwave	P40-16-XLPP-RR			
			3	Samsung	RRH-P4			
			3	Samsung	RRH-C2A			
			3		T-Frames			

Notes:

1) This layout represents the final installed configuration for Sprint. See the next page for the proposed coax layout.

Proposed Coax Configuration



#	CARRIER	SIZE	QTY.	ELEVATION	NOTES
1	T-Mobile	1-5/8"	11	162'	Existing
2	Clearwire	5/16"	3	152'	Existing
3	Clearwire	1/2"	5	152'	Existing
4	Clearwire	3/8"	6	152'	Existing-Inside 2" conduit
5	Nextel	1-1/4"	12	142'	Existing
6	Sprint	1-1/2"	3	120'	Proposed

Assumptions

This structural analysis is based on the theoretical capacity of the members and is not a condition assessment of the tower. This analysis is from information supplied, and therefore, its results are based on and are as accurate as that supplied data. GPD has made no independent determination, nor is it required to, of its accuracy. The following assumptions were made for this structural analysis.

1) Tower and structures were built in accordance with the manufacturer's specifications.
2) The tower and structures have been maintained in accordance with the manufacturer's specification.
3) The configuration of antennas, transmission cables, mounts and other appurtenances are as specified in the Existing/Reserved Loading and Proposed Loading Tables, and the specified documents.
4) All mounts, if applicable, are considered adequate to support the loading. No actual analysis of the mount(s) is performed. This analysis is limited to analyzing the tower only.
5) Mount sizes, weights, and manufacturers are best estimates based on photos provided and determined without the benefit of a site visit by GPD.
6) The proposed coax shall be installed in the location shown on the attached coax layout. The existing coax layout is based on photos and previous analysis by FDH.
7) All member connections and foundation steel reinforcing are assumed designed to meet or exceed the load carrying capacity of the connected member and surrounding soils respectively unless otherwise specified in this report.

If any of these assumptions are not valid or have been made in error, this analysis may be affected, and GPD Group should be allowed to review any new information to determine its effect on the structural integrity of the tower.

Tower Section Results

Capacity Summary of Structural Components

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	ϕP_{allow} K	% Capacity	Pass/ Fail
T1	180 - 160	Leg	ROHN 2.5 STD	3	-3.98	63.56	6.3	Pass
T2	160 - 140	Leg	ROHN 2.5 EH	37	-21.40	74.43	28.8	Pass
T3	140 - 120	Leg	ROHN 3 EH	67	-45.48	94.34	48.2	Pass
T4	120 - 100	Leg	ROHN 4 EH	88	-74.61	159.91	46.7	Pass
T5	100 - 80	Leg	ROHN 5 EH	109	-103.64	239.39	43.3	Pass
T6	80 - 60	Leg	ROHN 6 EHS	130	-129.99	244.06	53.3	Pass
T7	60 - 40	Leg	ROHN 6 EH	145	-158.18	303.71	52.1	Pass
T8	40 - 20	Leg	ROHN 8 EHS	160	-186.52	386.40	48.3	Pass
T9	20 - 0	Leg	ROHN 8 EHS	175	-214.72	386.40	55.6	Pass
T1	180 - 160	Diagonal	L1 3/4x1 3/4x3/16	9	-1.15	8.67	13.3 18.1 (b)	Pass
T2	160 - 140	Diagonal	L 2 x 2 x 3/16	46	-3.00	7.58	39.5 43.5 (b)	Pass
T3	140 - 120	Diagonal	L 2.5 x 2.5 x 1/4	73	-4.36	12.11	36.0 41.0 (b)	Pass
T4	120 - 100	Diagonal	L 3 x 3 x 1/4	93	-5.62	16.43	34.2 47.6 (b)	Pass
T5	100 - 80	Diagonal	L 3 x 3 x 1/4	114	-6.29	13.07	48.1	Pass
T6	80 - 60	Diagonal	L3 1/2x3 1/2x1/4	135	-7.61	14.39	52.9 53.4 (b)	Pass
T7	60 - 40	Diagonal	L4x4x1/4	150	-7.91	17.94	44.1 55.7 (b)	Pass
T8	40 - 20	Diagonal	L4x4x1/4	167	-8.95	15.48	57.8 62.2 (b)	Pass
T9	20 - 0	Diagonal	L4x4x5/16	182	-9.50	16.21	58.6	Pass
T1	180 - 160	Top Girt	L1 3/4x1 3/4x3/16	5	-0.04	3.02	1.5	Pass
T2	160 - 140	Top Girt	L 2 x 2 x 3/16	42	-0.01	4.58	0.6	Pass
							Summary	
						Leg (T9)	55.6	Pass
						Diagonal (T8)	62.2	Pass
						Top Girt (T1)	1.5	Pass
						Bolt Checks	62.2	Pass
						RATING =	**62.2**	**Pass**

Additional Capacities

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
	Anchor Rods	0	56.9	Pass
	Foundation	0	48.9	Pass

Disclaimer of Warranties

GPD GROUP has not performed a site visit to the tower to verify the member sizes or antenna/coax loading. If the existing conditions are not as represented on the tower elevation contained in this report, we should be contacted immediately to evaluate the significance of the discrepancy. This is not a condition assessment of the tower or foundation. This report does not replace a full tower inspection. The tower and foundations are assumed to have been properly fabricated, erected, maintained, in good condition, twist free, and plumb.

The engineering services rendered by GPD GROUP in connection with this Structural Analysis are limited to a computer analysis of the tower structure and theoretical capacity of its main structural members. All tower components have been assumed to only resist dead loads when no other loads are applied. No allowance was made for any damaged, bent, missing, loose, or rusted members (above and below ground). No allowance was made for loose bolts or cracked welds.

GPD GROUP does not analyze the fabrication of the structure (including welding). It is not possible to have all the very detailed information needed to perform a thorough analysis of every structural sub-component and connection of an existing tower. GPD GROUP provides a limited scope of service in that we cannot verify the adequacy of every weld, plate connection detail, etc. The purpose of this report is to assess the feasibility of adding appurtenances usually accompanied by transmission lines to the structure.

It is the owner's responsibility to determine the amount of ice accumulation in excess of the code specified amount, if any, that should be considered in the structural analysis.

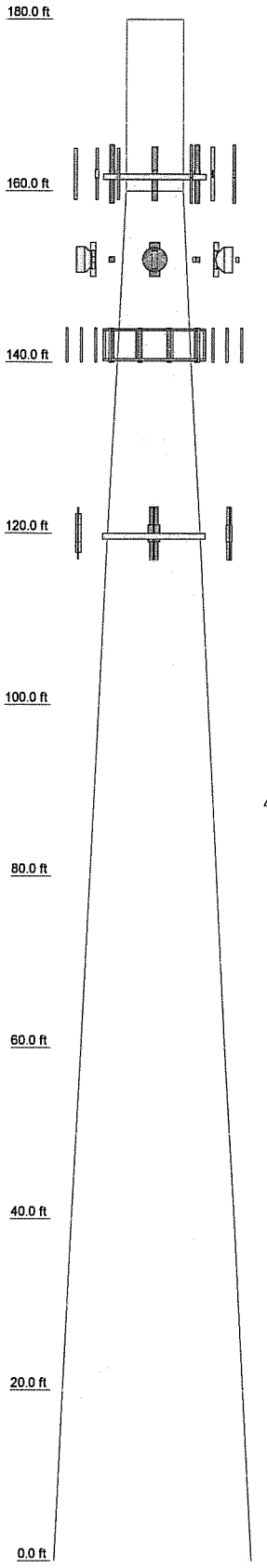
The attached sketches are a schematic representation of the analyzed tower. If any material is fabricated from these sketches, the contractor shall be responsible for field verifying the existing conditions, proper fit, and clearance in the field. Any mentions of structural modifications are reasonable estimates and should not be used as a precise construction document. Precise modification drawings are obtainable from GPD GROUP, but are beyond the scope of this report.

Miscellaneous items such as antenna mounts, etc., have not been designed or detailed as a part of our work. We recommend that material of adequate size and strength be purchased from a reputable tower manufacturer.

GPD GROUP makes no warranties, expressed and/or implied, in connection with this report and disclaims any liability arising from material, fabrication, and erection of this tower. GPD GROUP will not be responsible whatsoever for, or on account of, consequential or incidental damages sustained by any person, firm, or organization as a result of any data or conclusions contained in this report. The maximum liability of GPD GROUP pursuant to this report will be limited to the total fee received for preparation of this report.

TNX TOWER OUTPUT

Section	T9	T8	T7	T6	T5	T4	T3	T2	T1
Legs	ROHN 8 EHS		ROHN 6 EH	ROHN 6 EHS	ROHN 5 EH	ROHN 4 EH	ROHN 3 EH	ROHN 2.5 EH	ROHN 2.5 STD
Leg Grade	A572-50								
Diagonals	L4x4x5/16	L4x4x1/4		L3 1/2x3 1/2x1/4	L 3 x 3 x 1/4		L 2.5 x 2.5 x 1/4	L 2 x 2 x 3/16	L1 3/4x1 3/4x3/16
Diagonal Grade	A572-50						A36		
Top Girts	N.A.						L 2 x 2 x 3/16		L1 3/4x1 3/4x3/16
Face Width (ft)	23	19	16.8542	14.8542	12.8333	10.7604	8.6875	6.64583	
# Panels @ (ft)	21	8 @ 10			9 @ 6.66667			4 @ 5	5 @ 4
Weight (K)	23.3	4.6	3.9	3.5	2.8	2.7	2.2	1.6	1.1	0.9



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
4' Step Peg Extension	180	Horizon DUO w/ 3" x 84" mount pipe	152
(2) TMBX-6517-R2M w/ 6' Mount Pipe	162	MTS 72" HD Standoff (3)	152
APXV18-206517S-C-A20 w/ Mount Pipe	162	840 10054 w/ Mount Pipe	152
PCSA060-19-0 w/ Mount Pipe	162	VHLP2.5	152
PCSA060-19-0 w/ Mount Pipe	162	(2) VHLP2.5	152
(2) RR65-19-02DP w/ (2 1/2" x 72") Mount Pipe	162	(2) VHLP2.5	152
(2) ETD19V2S12UB	162	(4) DB844H90E-XY w/ Mount Pipe	142
(2) ETD19V2S12UB	162	(4) DB844H90E-XY w/ Mount Pipe	142
ATMAA1412D-1A20	162	(4) DB844H90E-XY w/ Mount Pipe	142
ETW190VS12UB	162	Rohn 15' Boom Gate (3)	142
ETM190VS12UB	162	RRH-P4	120
ETM19V2S12UB	162	RRH-P4	120
Pirod 12' Knockdown T-Frame (3)	162	RRH-C2A w/ EXT FILTER	120
(2) TMBX-6517-R2M w/ 6' Mount Pipe	162	RRH-C2A w/ EXT FILTER	120
840 10054 w/ Mount Pipe	152	RRH-C2A w/ EXT FILTER	120
840 10054 w/ Mount Pipe	152	Pirod 12' Lt. Wt. T-Frame (3)	120
WAP450 DAP	152	(2) Pipe Mount 6'x2.375"	120
WAP450 DAP	152	(2) Pipe Mount 6'x2.375"	120
WAP450 DAP	152	(2) Pipe Mount 6'x2.375"	120
(2) Horizon DUO w/ 3" x 84" mount pipe	152	ET-X-TS-70-15-62-18-iR-RD w/ Mount Pipe	120
(2) Horizon DUO w/ 3" x 84" mount pipe	152	ET-X-TS-70-15-62-18-iR-RD w/ Mount Pipe	120
		P40-16-XLPP-RR w/ Mount Pipe	120
		RRH-P4	120

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-50	50 ksi	65 ksi	A36	36 ksi	58 ksi

TOWER DESIGN NOTES

1. Tower is located in Franklin County, Ohio.
2. Tower designed for Exposure C to the TIA-222-G Standard.
3. Tower designed for a 90 mph basic wind in accordance with the TIA-222-G Standard.
4. Tower is also designed for a 40 mph basic wind with 0.75 in ice. Ice is considered to increase in thickness with height.
5. Deflections are based upon a 60 mph wind.
6. Tower Structure Class II.
7. Topographic Category 1 with Crest Height of 0.00 ft
8. TOWER RATING: 62.2%

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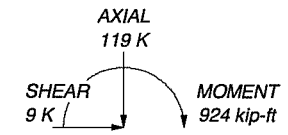
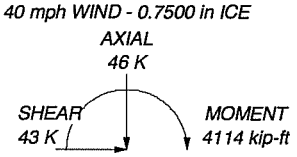
ALL REACTIONS ARE FACTORED

MAX. CORNER REACTIONS AT BASE:
DOWN: 222 K
SHEAR: 27 K

UPLIFT: -183 K
SHEAR: 23 K



TORQUE 1 kip-ft
40 mph WIND - 0.7500 in ICE



TORQUE 7 kip-ft
REACTIONS - 90 mph WIND

GPD GROUP
Consulting Engineers

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520 South Main St., Suite 2531
Akron, OH 44311
Phone: (330) 572-2100
FAX: (330) 572-2102

Job: *2012778.02759.01*			
Project: *Dublin 2*			
Client: SBA	Drawn by: J Stokes	App'd:	
Code: TIA-222-G	Date: 01/17/13	Scale: NTS	
Path: O:\2012\2012778\00 - Bucket\02759\01 Site Audit CDs SA\tnx\02759.01.eri		Dwg No. E-1	

tnxTower	Job	Page
	2012778.02759.01	1 of 1
GPD Group 520 South Main St., Suite 2531 Akron, OH 44311 Phone: (330) 572-2100 FAX: (330) 572-2102	Project Dublin 2	Date 17:14:50 01/17/13
	Client SBA	Designed by J Stokes

Critical Deflections and Radius of Curvature - Service Wind

Elevation	*Appurtenance*	*Gov. Load Comb.*	*Deflection*	*Tilt*	*Twist*	*Radius of Curvature*
ft			*in*	°	°	*ft*
180.00	4' Step Peg Extension	47	3.170	0.1436	0.0068	Inf
162.00	(2) TMBX-6517-R2M w/ 6' Mount Pipe	47	2.627	0.1424	0.0065	Inf
152.00	VHLP2.5	47	2.325	0.1388	0.0058	154296
142.00	(4) DB844H90E-XY w/ Mount Pipe	47	2.031	0.1323	0.0049	67127
120.00	ET-X-TS-70-15-62-18-iR-RD w/ Mount Pipe	47	1.449	0.1098	0.0036	52621